

Ecologically Sustainable Development (ESD) Useful Australian Land Use Practice-Suitable for the World

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Abstract: Protection of the Environment and Sustainability goes hand in hand as one mechanism compliments the other. On the other hand, Sustainable Economic Growth can only be achieved if it is linked to Ecologically Sustainable Development (ESD). Sustainability can best be described as "Living within the limit of what the environment can provide while safe guarding the environment for future generation, Understanding the many connections between environment, society and economy, and equitable distribution of resources and opportunities". Uncontrolled Green House Gas Emission has caused global warming, sea level rise, change of weather pattern (e.g severe untimely rainfall at unusual location), and alarming increase of natural disasters (Cyclone, Hurricane, Floods, Tsunamis and other natural phenomena). Third world countries are worst affected by the Green House Gas Emission and Global Warming Impact and Bangladesh is one of them. UN has taken a leading role and guiding the world to work together not only to reduce pollution but to make significant contribution in achieving pristine environmental conditions. Under the umbrella of UN, the world is now taking collective action to reduce Green House Gas Emission and Tackle Global Warming Impacts. Concerted efforts must be taken in an accelerated pace to educate at Global, Regional, National and Community level, about the benefits of the above-mentioned concepts and introduce incentive-based programs for mass participation. The environmental cleanup process should start from individual home and gradually extending to community, national and global level to achieve accelerated measurable success. An opportunity must be created to reform land use change, replacing pollution producing industries with environmentally sustainable practices. It is overdue to put through a series of EPA recommended processes to clean up the contaminated land, soil and water and secondly, introduce and adapt an Ecologically Sustainable Development program. The long-term goal should be to expedite and spread the land use change practices to relace the contaminated practices and introduce mandatory adaption of environment friendly technology for the ongoing industrial and business activities to reduce pollution while contributing improving the environment. With a global collective action this world can be transformed into a heaven on earth.

Keywords: Environment, Sustainable, WSUD, Sustainability, Ecosystem, Biodiversity, Greenhouse gas emission, Global warming.

1. Introduction

Ecologically Sustainable Development, Protection of Environment and Environmental Management of Land, and Water Sensitive Urban Design, are the fundamental concepts and principles to build a sustainable future world. To put a halt to further environmental degradation, to begin pollution cleanup caused by the western industrial revolution in the past, to reduce the greenhouse gas emission and to adapt with the climate change impact sustainable development practice has no alternative. Since the introduction of Quadruple Bottom Line (QBL) concepts, Australia has adapted a sustainable development practice in its highest capacity in every sphere of development and its strict compliance is protected by regulatory requirements [1]. The purpose is to put a halt to the pollution, promote environment friendly land use change and upgrade the existing land use to make it more environment friendly. The primary aim is to identify the present environmental and functional problems and stresses. Identify as far as possible, the potential capabilities, constraints and opportunities as they apply to the future use. Formulate the short term and long-term actions plan and formulate the environmental management scheme.

The goal is to spread the land use change practices to other pollution producing industries and businesses, clean-up the contaminated land, soil and the groundwater through a series of EPA recommended established remedial measures. All ongoing businesses are to be encouraged to adapt pollution free technology and reuse and recycle raw and processed materials where possible and making environmental auditing mandatory for all industries and businesses. Environmental auditing will identify where to make improvement and will make the business more sustainable and profitable in the long run. This practice will bring positive benefit to environment, society and economy. During the western industrial revolution people had very little or no knowledge about the environmental pollution and how it can affect our globe that we live in and the deleterious effect that it would cause to our ecosystem. The massive unplanned growth of industries has produced our greatest concern about: Global Warming, Green House Gas Emission, Sea Level Rise, Salinity Increase, Change of Weather pattern (too much and too little rain fall, untimely rainfall, rise of temperature, Tsunamis and others), an increase in Natural disasters (Cyclone, Tornadoes, Floods, Tsunamis, Hail Storm, Severe Bushfire and others), occurring untimely and at unusual locations. Based on the foundation of environmental management of land and applying the concept of ESD, the current project is an attempt to make a positive contribution for the development of the local environment which is constantly being polluted by the industrial expansion.

1.1. Concepts and Approaches of Sustainability

The concept of sustainability was first introduced in a report entitled "Our Common Future" (Brundtland Commission Report) [1]. Prepared under the direction of United Nations by the World Commission on Environment and Development, the report sought to create a future which equally balanced economic, social and environmental needs, with the addition of governance. This is known as a Quadruple Bottom Line approach [1]. With this declaration in mind, sustainable development was defined as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In its full conceptualization, a sustainable world has been suggested to include enough access to resources for even multiple billions of people to meet their various environmental and socio-economic needs, as well as for multiple millions of other species to coexist and thrive with humans, as both human and rest of the nature continue to evolve [2]. This vision can include global scale aspects such as healthy biosphere, stabilized world human population, intra- and intergenerational equity, universal human rights, and the resolution of social and economic challenges of the world's poor, among other mega challenges and opportunities, such as our energy future [3]. Since the publication of Brundtland Report the global awareness in achieving a sustainable world in individual, communal and national level is steadily increasing and more people than ever appear to be learning about and trying to take more substantiate, more frequent and or more numerous actions in reducing energy consumption, improving water quality, recycling or reusing "waste" product, upgrading their own or their stakeholders health, and assisting in improving their community's socioeconomic sectors.

1.2. Ecologically Sustainable Development (ESD)

Ecologically Sustainable Development requires the effective integration of economic and environmental considerations in economic development activities. To maintain this process everyone engaged in decision making and development activities must be accountable and adapt full scale Regulatory Compliance. Ecologically Sustainable Development can be achieved

through rational use, enhancement and conservation of resources so that ecological processes are maintained, and the total quality of life continues to increase forever. ESD aims to meet the needs of today's generation and conserve healthy ecosystems for future generations. This requires prudent management and use of environmental resources which form the basis of the economy so that resources are not only maintained but where possible, improves their range, variety and quality and enhance sustainable growth. Bangladesh is making good progress. Its GDP has never gone down below 5 for many years even under complex political turmoil; otherwise, the growth rate would have been much higher. Political stability is a precondition for achieving ESD. Public awareness coupled with strict adherence to Legislations, comparable to international standard must be formulated to protect and maintain ESD. Ecologically sustainable development must embrace the following two approaches:

- Consideration and Integration of National Economic, Social and Environmental implication with wider Global Community, Atmosphere, Biosphere, Hydrosphere and Geo-sphere; and
- Adherence to long term view in Decisions making in opposed to short term view.

Ecologically sustainable path of development will reduce the likelihood of serious environmental impacts arising from economic development activity. ESD, means changing our patterns of resource use, including improvements in the quality of our air, land and water, and in the development of new, environmentally friendly products and processes.

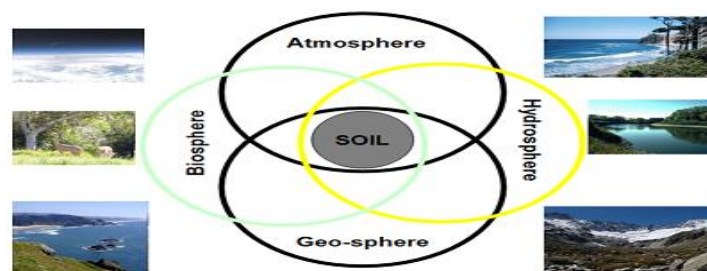


Figure 1.
Graphic representation of Soil Ecosystem (source: Rimmer, 1999).

1.3. Steps in Protecting Environment

The following simple but very important steps are involved in protecting the environment. These steps are as follows:

Identification of Potential Pollution Elements: (a) Water Pollution (Surface Water and Ground Water) (b) Air Pollution (c) Climate Change (d) Noise Pollution (e) Land Pollution and Waste (f) Odour and (g) Human Health. Littering of public places is completely unacceptable. Apart from obvious visual impacts, litter pollutes our Land, Air and Waterways and foreshores, blocks drains, harms the health of wildlife, and can be a fire hazard.

Action to be taken to protect Pollution Elements: Effective positive actions must be taken to minimise further environmental degradation. These activities are well performed by:

- Educating nation about the importance and benefits of environment protection
- Protecting and conserving natural resources
- Recycling and reusing resources and
- Use of more energy efficient or environmentally friendly products.

Such activities are not only beneficial to the environment but collectively they are great contribution to individual savings and significant contribution to national economy.

Knowledge Dissemination: Environmental awareness can be greatly enhanced through education via academic curriculum, through various electronic Medias and through mobile phone networks.

Pollution Control: Pollution has many sources such as: Land Pollution (from littering and waste disposal), Air Pollution [4] (Air pollution is the toxic particulates and gases suspended in the air that are created by human activity such as driving, producing electricity, and industrial pollution and others), Noise Pollution (noise through vehicle, industrial activities and real estate construction and other noise source), Odour Pollution (resulting from the release of H₂S and other gaseous substances due to biochemical activity of microorganism) and Biological pollution (presence of pathogenic bacteria causing harm to human health).

Recycling: Mandatory recycling practice to be introduced in every house hold, every office, organization, educational institution. Protection of the sanctity of public places (such as park, playground, recreational centre etc) by imposing penalty for littering and making it easier for visitors to dispose off their litter by installing more collection points and by frequent collection of litters from public places by the appropriate authority.

Water Conservation: Water conservation [5] through education and by regulations is to be introduced in every sphere of life. Everyone should be educated and should have clear understanding about the importance and necessity about water conservation. Few examples of water conservation are:

- Use of rain water (or recycled water) in the garden and household washing and toilets
- Use of more water efficient products within the house such as reduced flow shower heads and dual flush toilets in every house hold and office blocks
- Less frequent use and only washing full loads of clothes in the washing machine
- In Australia installation of rain Water Tank has become a mandatory requirement for any new building construction to obtain occupancy certificate from the Council.

Moreover, construction of "Artificial Wetlands" has also been made mandatory for all development of new suburbs [6]. This will bring multiple benefits to water resources management, water conservation, and environmental development and put in place the WSUD (Water Sensitive Urban Design) concepts.

Promotion of Green, Renewable and Reusable Energy: In Australia Coal Generated Electricity is still the dominant source of Energy but the awareness and popularity of green energy is rising. In Tasmania power is predominantly sourced from hydroelectricity. Solar energy and Wind energy are already in use and their popularity is increasing rapidly and network increasing.

Energy Efficient Products: Nationwide encouragement must be carried to use energy saving products (such as long-life electric bulbs, AC, Refrigerator, Computers, Mobile phones and energy saving sensor must be attached where applicable) and their easy availability must be ensured. Incentives should be provided to the manufacture of energy efficient products. Other electrical appliances not mentioned above should also be energy efficient products wherever possible.

1.4. Sustainable Land Management

Land may be considered as the mother of all resources as it supplies all the food (naturally grown or we grow them on soil) on which all living creatures survives on and it becomes the foundation of upon which all structures are built (Dream homes, business, Industries etc.). It supplies all the natural material that is required to build all structures. All precious natural resources are hidden underneath. Sustainable land management means managing land without damaging ecological processes or reducing biological diversity (Figure 2).



Figure 2.
Classic example of modern sustainable development in Hong Kong (sources: UTS academic resources 2013).

It requires the maintenance of the following key components of the environment:

- **Biodiversity:** the variety of species, populations, habitats and ecosystems;
- **Ecological integrity:** the general health and resilience of natural life-support systems, including their ability to assimilate wastes and withstand stresses such as climate change and ozone depletion; and
- **Natural capital:** the stock of productive soil, fresh water, forests, clean air, ocean, and other renewable resources that underpin the survival, health and prosperity of human communities.

Land is often managed for multiple benefits, such as agricultural production, biodiversity conservation, water quality, soil health and supporting human life. To ensure long-term sustainability, land managers need to consider economic, social and environmental factors. Sustainable land management includes: (1) Application of environmental management system, (2) Protecting native vegetation through best management practice and (3) Monitoring and Evaluation. Critical Evaluation, interpretation, of the physical and social limitations on urban and semi-urban land use change and devise sustainable development and management strategies includes the following items:

- Concepts and issues involved in the discipline of land resource management.
- Composition, structural functional, economic, legal, risk and social aspects of land management.
- Responsible environmental ethics and aesthetic awareness with respect to the management of land.
- Observe natural and cultural phenomena of land resource management.
- Interpret or analyze their observations of responsible environmental ethics and aesthetic awareness with respect to the management of land.
- Prescribe alternative opinions by describing constraints and limitations.

1.5. Water Sensitive Urban Design (WSUD)

The Water Sensitive Urban Design is a new Australian Approach to urban planning, compared to the wider international approach of integrated planning and management [7]. The integrated management combines the land and water management with the addition of natural vegetation as part of architectural design of urban landscape to provide a natural look while adapting more economical and environmentally appropriate solution. WSUD has a key relevance to Ecologically Sustainable Development. In its broad context, WSUD encompasses all aspects of integrated urban water cycle management, including water supply, sewerage and storm water management. This new approach is based upon the premises that the processes of urban development and redevelopment need to address adequately the sustainability of the water environment, as water is increasingly seen as a limited finite resource. The conventional municipal management is seen as being:

- Wasteful of water resources;
- Wasteful of public infrastructure; and
- Detrimental to Riverina, estuarine and marine environment.

By contrast, a WSUD based approach adopts a planning and design approach that aims to integrate the following opportunities into the built form of cities and town (Figure 3):

- Detention of stormwater, rather than rapid conveyance;
- Utilization of stormwater to conserve potable water;
- Use of vegetation for filtering purposes;
- Water efficient landscaping;
- Protection of water related environmental, recreational and cultural values;
- Localised water harvesting for various uses; and
- Localised wastewater treatment system.



Figure 3. Classic Example of WSUD in Japan (source: UTS academic resources 2013).

WSUD aims to find ways to bring considerations of the water environment and infrastructure service design and management opportunities earlier into the decision-making processes associated with urban planning and design. WSUD has emerged as a practical planning and design approach that seeks to bring a single management framework to the issues that traditionally have been considered in isolation [8]. The range of relevant issues Water Sensitive Planning Guide for the Sydney Region is wide and includes:

- Water quality in streams and water bodies
- Aquatic and riparian ecosystems and biodiversity
- Flood management
- Water, sewerage and drainage infrastructure
- Erosion and sediment control
- Efficient water use
- Stream management
- Scenic, aesthetic, recreational and cultural aspects of water bodies
- Catchment-wide management of soils, forests, estuaries, coastal waters and other natural resources.

1.6. Importance of Regulations and Legislations

The wisdom guides human being to respect the law of the land. Fulfillment of Regulatory requirement has become an obligatory requirement for everyone involved in all development tasks. Some of the highlights of Australian legislations are given below:

- (a) Committing Environmental Offences in the Eyes of Law if:
 - Disposal of waste-harm to environment.
 - Pollution (air, water, and land) exceed recommended threshold limit.
 - Leaks, spillages and other escapes.
 - Emission of ozone depleting substances.
 - Oceans, seas and other water bodies are polluted by oil and noxious substances.
 - Healthy Biodiversity becomes endangered.
 - Climate Change and Environment Protection becomes affected.
- (b) Failure to notify pollution incidents.

1.7. Adoption of ESD-Through Land Use Change-An Australian Example

Project Spatial Location: The suburb of Minto located within the Global Coordinate System (latitude and longitude) of 34.0265oS and 150.8507oS (Figure 4b). The suburb of Minto (post code 2565) is a part of Campbelltown City Council which is again a part of Cumberland State Districts [9]. The project area (Minto) was named after the viceroy of India and Earl of Minto. The Minto area is somewhat naturally defined by Bow Bowing Creek in north-eastern boundary and Myrtle Creek in the south-eastern boundary. In terms of district boundary, Minto is bounded by Ingleburn in the north, Minto height in the East, Leumeah in the South and by St. Andrews in the east.

Site Specification: The actual site is a small land located on Ben Lomond Road at the intersection of Minto Mall boundary and Ben Lomond Road (**Figure 4a**). The site is currently occupied by a Service Station which is going through the process of decommissioning. Prior to that the land was traditionally used for agricultural purposes.

Physiographic or Physical Settings: The greater Campbelltown Catchment is characterised by two distinct physiographic regions (**Figures 4b and 5**). In the south and east, the Georges river and its right bank tributaries flowing northwards from relatively high elevation (300>400 meters) which was formed by up-warping of Hawkesbury Sandstone, resulting in the typical plateau and deep ravine topography.



Figure 4a.
Location of Minto Project Area.

The second physiographic region is found north and west of the main channel. To the west, the Wianamatta Shale series overlies the sandstone and form the gently sloping, well rounded topography. The elevation of these region is generally well below 100 meters. Their floors are occupied by wide flood plains, and the valley sides are gentler than those found in the sandstone regions (**Figure 5**).

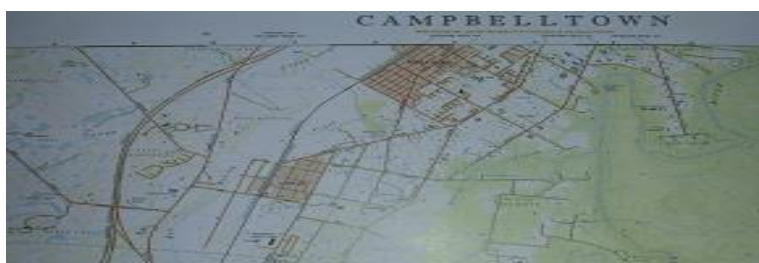


Figure 4b.
Physiographic Map of Campbell town District.

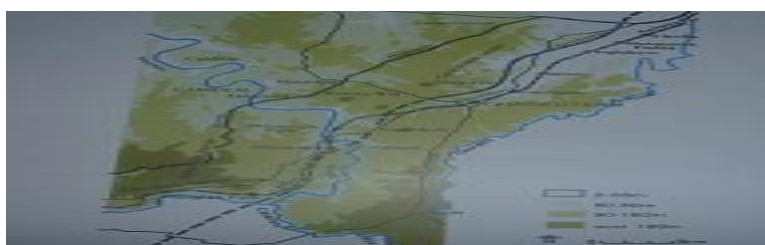


Figure 5.
Topographic Map of Campbell town Districts.
(Source: LGA development report Plan, 1973).

Geology: The Sydney Basin came into existence because of earth movements during the mid-Permian (270 million years ago) and for the next 70 million years, Permian Triassic was subject to periodic episodes of marine transgressions and regressions which alternately inundated and exposed the developing basin [10]. The Geology of Greater Campbelltown and the adjoining areas are of Triassic Age, and are broadly sub-divided into the following three major successions:

- Wianamatta Group,
- Hawkesbury Sandstone Formations and
- Narrabeen Group,
- The Hawkesbury Sandstone conformably overlies the Narrabeen Group and the Wianamatta Group conformably overlies the Hawkesbury sandstone.

Soil Classification and Characteristics: The soil of Campbelltown has been mapped and classified by [11]. He found that parent rock played the most important role in distribution of soils. In order of importance main soil associations are:

- Hawkesbury Associations (on Hawkesbury Sandstone)
- Hammondville association (on Passage Beds)
- Cumberland Association (on Wianamatta Shales)
- Elderslie Association (on Old River Terraces) and
- Nepean Association (on Young alluvium)

A field work has been completed. An examination of soils at outcrop (**Figure 3**) has confirmed that the project site is situated on the foundation of Wianamatta Shale (**Figure 6a**).



Figure 6a.
Soil Landscape Map of Campbelltown.

The soil characteristics range from Hammondville Association to Cumberland Association as properties of both Associations has been observed in the exposed soil. The detailed Soil Landscape Mapping (Wollongong-Port Hacking, Soil Landscape Series-Sheet 9026-9129, and Edition 1 Reprint) classified soils of greater Campbelltown (Minto) area as follows: (1) Blacktown Soil (bt) Assemblages (bt) belongs to Residual Landscape association; (2) South Creek (sc) Assemblages belonging to Alluvial Landscape Association; and (3) Lucas Heights (lh) Assemblages belonging to Colluvial Landscape Associations. The project area lies on the Blacktown Soil (bt) Assemblages (**Figure 6b**).

Climatic Conditions: The climate in this area is classified as temperate maritime, with warm to hot summers and cool to mild winters. Frosts occur occasionally in the cooler months.



Figure 6b.
Outcrop showing soil characteristics with deep cracking and shale fragments (author own research, 2014).

Rainfall and Temperature: Rainfall distribution throughout the year tends to be bimodal, that is two relatively wet period periods January and June are separated by relatively lower rainfall throughout the year. Early January 2013 and Late February 2013 has experienced the two most heavy rainfall events, making a record of 50 years high.

This severe unusual rainfall event during uncommon periods is a strong indication yet that weather patterns are changing. Maximum daytime temperature averages range from 17°C in July to 28°C in January and 17°C in July to 30°C in January, indicating slight increasing in temperature (2°C) during summer. January 2013 was recorded as the hottest month in the century during this time in some days temperature was recorded as high as 46.5°C (**Table 1**).

Table 1.

Average Rainfall and Temperature Pattern in Campbelltown (Mount Annan) Area from 2006 to 2012.

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Max (°C)	30	28	27	23	21	18	17	19	22	24	27	27	24
Mean Min (°C)	17	17	15	11	7	6	4	5	8	10	14	15	11
Mean Rain (mm)	58	127	82	67	56	91	38	32	41	53	90	60	803
Median Rain (mm)	41	77	53	41	49	61	26	32	38	49	84	56	726
Mean Rain Days	11	11	13	11	8	13	10	8	9	11	11	14	102

(Source: www.weather.farmonline.com.au).

Winds are chiefly light and variable with a tendency towards westerlies in the winter months. In summer months, particularly in the afternoon, wind tends to be easterly. Severe floods have been experienced in 1873. The greatest flood this Century was in 1956. Major and prolonged (up to 14 months) droughts have occurred in the past. Droughts exceeding three months are not uncommon and droughts of several months can be expected in any year.

1.8. Current State of the Environment in Campbell Town

Land Resources: Traditionally Campbelltown has been identified and recognised as important farm land areas and huge abundance of mineral resources are also stored underneath. Campbelltown is the fastest growing district in Sydney because of its huge Land Resources. Development of new suburban areas, infrastructure, industrial and businesses are taking place at a much faster rate than any other parts of Sydney.

Water Resources: Today's water resources management is focused on optimum usage, minimum wastage, providing greater benefits to the environment and maintenance of a vibrant ecosystem and greater social acceptance. The new approach of integrated management practice faces challenges effectively, conserve our resources efficiently and above all to achieve environmentally sustainable development.

The key objective here is to close the "water loop" by preventing wastage and pollution of water resources and re-use water whenever possible. Campbell town is located within the catchment of two Principal Sydney waterways, The Georges River and Nepean River Systems. Overall water quality in the catchment remains fair. Water Quality Monitoring is carried out in line with the National Guidelines for Fresh and Marine Water Quality [12]. Under the updated strategy, Risks associated with Recreational waters are handled as per NHMRC guidelines [13].

Air Pollution: Air pollution is normally defined as the contamination of the oxygen and atmospheres around us [14]. Since 2008, pollutant data s recorded at monitoring stations are represented as the Regional Air Quality Index (RAQI) The RAQI based on the five criteria pollutants (ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide and air particles) plus visibility (NSW Standard) (**Figure 7**). The RAQI values are categorized as follows: Very good: 0-33; Good: 34-66; Fair: 67-99; Poor: 100-149; Very Poor, 150-199; and Hazardous: >200. When compared with previous year data it shows that the RAQI has declined confirming significant achievement in Air Quality Improvement.

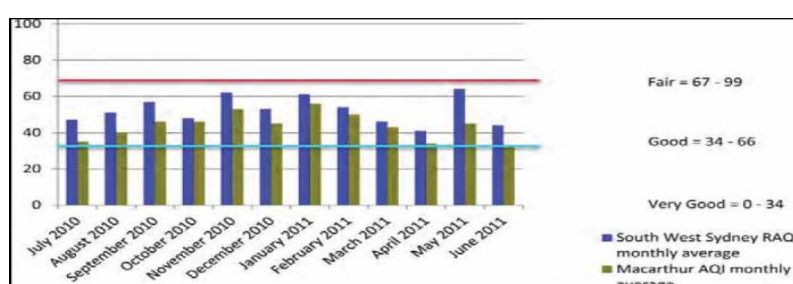


Figure 7.
Comparison of Macarthur RAQI and Sydney South West AQI (2011-12).

Biodiversity: Life on the earth comprises at least 10 million species of plants, animals and microbes, of which small organisms such as anthropods and microbes comprise 95 percent. Biodiversity is the web of life. It is the variety of living things - the different plants, animals and micro-organisms, the genes they contain and the ecosystem of which they form part of. Biodiversity is essential for our survival sustainable functioning of agriculture, forest and natural ecosystem and provides benefits such as: (1). Ecosystem services such as clean air to breathe; and (2). biological resources such as food and medicines. Biodiversity reserves include vegetation with local indigenous plant and animal species (**Figure 8**) reserves include vegetation with local indigenous plant and animal species.



Figure 8.
Rabbits population in Campbell town.

The Marsden Park Water wise Garden was designed to educate the community on types of gardens and plans that require reduced water maintenance and that could enhance local biodiversity (**Figure 9**).



Figure 9.
Marsden Park Multipurpose Garden to enhance local biodiversity.

Sustainability: After the Brundtland Commission Report, the Council of Australian Governments endorsed the National Strategy for Ecologically Sustainable Development [15]. The strategy further defined ecologically sustainable development (ESD) as: "Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased". In pursuing the incorporation of sustainability, Campbelltown aims to minimise wastes, conserve water resources, reduce energy consumption and promote solar energy, recycle and reuse where appropriate, conserve environmental assets and reduce greenhouse gas emissions (**Figure 10**).



Figure 10.
Sources of Alternative and renewable energy (solar energy).

1.9. Proposed Land Use Change Project

Current Land Use: The project area is currently being used as a petrol gas service station (Photo. 5,6,7,8). Service stations play a dominant role in polluting the surrounding environment, the soil on which it was built and occasionally it also pollutes the sub-surface environment including the groundwater resources. A consequence which is very much undesirable.

Proposed Land Use Change (Child Care Centre): The proposed land use change will bring two-fold benefit to the society: (1). It will clean the polluted environment; and (2). A good child care centre has the capability to train the children to become an ideal citizen for tomorrow. The remediation will bring long term sustainability. This is a great opportunity to bring multi-faceted benefit to the soil, land, water, biodiversity and environment. It is an ideal example of ESD.

1.10. Possible Constraints, Limitations and Attributes

Physical Settings:

- There should be minimal physical constraints because:
- Soils are already prepared for the construction of physical structures - an attribute.
- There is no vegetation cover as the site is fully concreted to make it suitable for the service station - an attribute.
- Slope adjustment has been completed for the service stations- an attribute.

1.11. Dealing with Contamination

Permanent Site Decommissioning: Decommissioning begins with the following tasks: (1) The tanks made safe, together with the corresponding pipe works, and safe removal from installation site; (2) The dispenser removed, and the electrical installation disconnected; and (3) The separator/interceptor cleaned. Following the closure, the site will remain dormant for a considerable time as per EPA requirement.

Soil-Gas Survey and Site Investigation: A full-scale site assessment must be carried out by a professional licensed Assessor. The assessment will conform Australia guidelines [12]. The Site assessment will be followed by a detailed field investigation as per EPA guideline (detailed in: www.esdat.net/environmentalstandards/Australia/service_stnsites.pdf) and will be documented in a Site Assessment Report.

Groundwater Contamination and Assessment: Groundwater samples will be collected and analyzed and remediated following EPA Australia recommended procedures. If contamination found then the extent of off-site migration will be mapped, and appropriate management practice will be put into practice to remediate contamination to make it safe for all users employing full regulatory compliance.

Remediation of Contamination: The remediation strategies will consider the environmental impact of the actual remediation operations, including the impact on the air quality, water quality, noise level and waste management. EPA preferred technique will be followed to remediate contaminated soil and/ or groundwater at service station site [12,15-17].

Benefits of Remediation: The treatment will reduce the amount of VOCs including benzene. Cap and Contain" strategy, both on-site and off-site controlled remediation will eliminate the need to use valuable landfill space in metropolitan areas. Community confidence will be greatly increased. Reducing potential public health risks. A great boost to environmental health.

Risk Assessment: Risk assessment has become an essential integral part of quality assured environmental management systems [18]. NSW Department of Planning Environmental risk analysis deals with the probability of an event causing a potentially undesirable effect. Risk assessment has become an objective tool to set standard, set priorities and help in decision making (**Figure 11**).

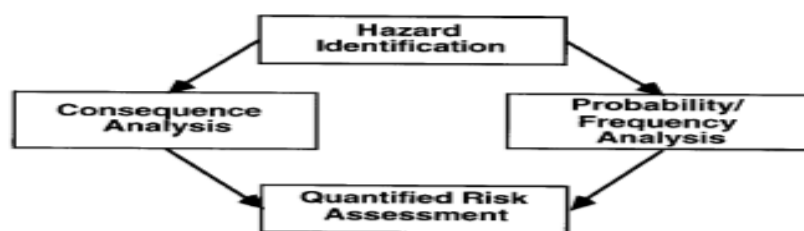


Figure 11.
Hazard Analysis Methodology (Department of Planning, NSW, 1994).

Australian Approach to Risk Assessment: The hazard assessment introduces assessment and calculated of "Q" value. A "Q" value greater than 0.1 will lead to further examination of environmental hazard including other pathways of environmental contamination. The Environmental Impact Assessment (EIA) process as undertaken in Australia is a qualitative environmental risk assessment [12]. Canada has three step (**Figure 12**) processes of health risk assessment and risk management (1) Hazard Identification, (2) Risk Estimation and (3) Option Evaluation [19].

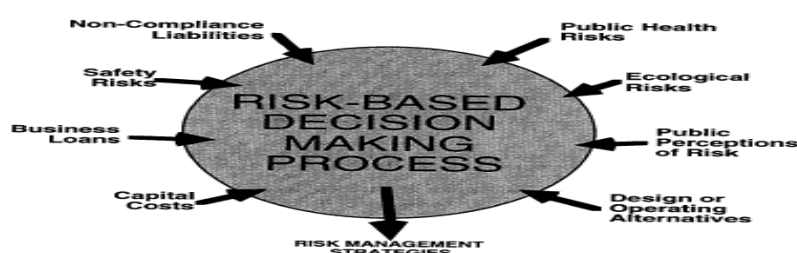


Figure 12.
Canadian Model of integrated Risk Management.

1.12. EPA Clearance Certificate

An EPA Certificate on No Further Action Letter can only be issued if: All previous requirements have been adequately addressed, All surface and sub-surface soils have been declared free from contamination and is suitable for redevelopment, All sources of groundwater contamination have been eliminated, Ambient soil and groundwater quality standards are not violated, All hazardous metals and/or chemicals including VOCs have been removed as practically as possible; and EPA has determined that all cost recovery issues have been resolved.

Meeting Community Concerns and Complaints: Community Engagement and meeting their concerns and complaints are part of the process for any development in Australia.

Meeting Legal Requirements and Obligations: Remediation of contamination is a legal obligation and must be completed to the full extent to obtain a license to operate a child day care center.

Certificate from Day Care Licensing Authority: The authority will only issue an operating license when all the requirements have been fully met [20].

Council Development Approval (DA) Certificate: Council will only issue DA Approval Certificate once they are fully satisfied that the application package had met fully the legal and other requirements.

2. Summary and Conclusions

The proposed land use change will be a significant positive contribution to the local environment in general and at the same time it will help clean up a contaminated site. The cleanup process will put a permanent stop to the going process of contamination of the surface soil and to some extent sub-surface soil and possibly shallow groundwater aquifer. The remediation will bring long term sustainable environmental development to the area. The multi-faceted benefit to the soil, land, water, biodiversity and environment of the local government area is a significant forward positive step in bringing long term sustainable environmental development for Australia. The site assessor will submit detailed reporting in several stages:

Stage 1: Preliminary Work Plan

Stage 2: Site Assessment Report

Stage 3: Draft Remedial Action Plan and

Stage 4: Final Report, including Site Validation.

The purpose of this project is to bring multiple benefits to the environment and social development:

- To put a halt to the pollution caused by the existing practices;
- Clean-up the contamination,
- Establishment of environment friendly practices; and
- To make significant contribution in social development through the establishment of a Child Day Care Centre.

The primary aim is to identify the present environmental and functional problems and stresses. Identify as far as possible, the potential capabilities, constraints and opportunities as they apply to the future use. Formulate the short term and long-term actions plan and put those environmental management schemes in practice to make long term contribution for Australian environment. The immediate goal is to decontaminate land, soil and the groundwater through a series of recommended established remedial measures. The long-term goal is to spread the environmentally friendly land use change replacing pollution producing enterprises and upgrading all on going enterprises by adapting more environment friendly technology. In Australia for any development project to go ahead public participation is part of the decision-making process creating greater community confidence. The community will be notified about the level of contamination detected, the site has been remediated with full regulatory compliance, site validation report will be submitted to EPA and the regulators (EPA) will issue a certificate of no further action required, as the soil and groundwater contamination have been detected, remediated and potential public health risks has been minimized.

Ongoing monitoring practice will protect of the environment from potential future contamination. The main water source of the City of Campbell town is "The Georges River and The Nepean River Basin Catchment. The goal is to make significant progress in water conservation and improving water quality by putting in place integrated resource management and development practices. As part of integrated management practice, maximum utilization of Rain Water will be prioritized. In Australia, occupancy certificate for all new building (domestic and industrial) construction has been attached with mandatory installation of rainwater tank. Moreover, construction of "Artificial Wetlands" has also been mandatory for all development of new suburbs. This will bring multiple benefits to water resources management, water conservation, and environmental development, put in place the WSUD to achieve ESD.

Due diligence Risk Assessment has been made as a mandatory task for any new development construction and must be carried out by licensed experts. They will make sure that step by step risk assessment elements have been taken into consideration in establishing the proposed development project. An EPA Certificate on No Further Action Letter can only be issued if: All previous requirements have been adequately addressed, All surface and sub-surface soils have been declared free from contamination and is suitable for redevelopment, All sources of groundwater contamination have been eliminated, Ambient soil and groundwater quality standards are not violated, All hazardous metals and/or chemicals including VOCs have been removed as practically as possible, EPA has determined that all cost recovery issues have been resolved.

3. Recommendations and Suggestions

For greater success in any initiative the government must play the leading role to educate the public because of the past miss deeds and lack of knowledge caused enough damage to the planet due to industrial revolution in which Australia also took a leading role along with Europe and North America. Wherever possible pollution producing industries and facilities should be replaced with environment friendly institution and enterprise. Where replacement is not possible they should be renovated and/or upgraded with the most modern environment friendly technology so that pollution producing can be brought down to an absolute minimum.

Industry sector and urban areas produces the highest amount of greenhouses gas emission (about 70%) and urgent actions are needed to a curb them without further delay by creating more eco-friendly parks wherever possible. Very old building (such as asbestos associated and other harmful construction) should be demolished and replaced with WSUR construction (e.g. Appendix. 2,3). Heritage Listed Building must be preserved but they should be upgraded and be given the best possible environmentally sustainable facelift so that they play a leading role in show casing WSUD and become the focal point of sustainable development which will encourage others to follow suit. To do that Government has to take the leading role and provide incentives to encourage general public because public participation always brings success.

Petrol and diesel used in Automobiles and in many industrial sectors is a major source of pollution to the environment. Environmentally friendly management practices must be put into practice and it can be done in the following ways:

- Production of environment friendly automobiles should be given the highest priority (example hybrid car, solar car or wind driven car)
- Renewable eco-friendly energy source should be readily available and where possible should be used to replace petrol and diesel and
- Service station should be more vigorously regulated and their distribution in urban area should be reduced while setting up some new ones in rural areas and making it more environment friendly with modern environment friendly equipment and setup.

Old style and design Heating and Cooling System should be replaced with 5 star rated systems. Housekeeping system should be improved and its operation should be fitted with sensor system i.e. when not needed it can go into sleep saving

energy and making it more environment friendly and sustainable. Lighting System is an essential part of our daily life without light our life would be nonexistent. Energy efficient and long-life bulbs should be used in all walks of life. Sensors should be attached to most of light sources which are not frequently used. Nationwide program should be organized to educate public about the importance and benefits of energy savings and train them up so that they become efficient user of energy and be responsible and take the initiative to switch them off when not in use, which would be a great favor to the environment.

Use of normal Plastics (such as water bottle, polyethylene bags and other products) should be replaced with biodegradable ones. Its use should gradually be limited and replaced at a much faster rate with environment friendly alternatives (for example all park should be provide with drinking water taps and people should be advised that those facilities have been installed and there is no need to bring water bottles with then anymore and in fact government may consider a ban in bringing those items to public amenity parks. Use of Computers, Mobile Phone, and other electronic devices has become part of our daily life. Computer and Mobile Phones has brought revolution to out communication technology and many more surprises are yet to come but they are all energy dependent. Use of Computer, emails and web browser system has successfully reduced paper usage to its minimum making a great contribution to the environment. But on the other hand, it has created two big problems: (a) It has significantly increased the usage of energy; and (b) Producing more greenhouse gas emission which is not desirable at all. One suggested solution could be a mandatory switch off and unplug computers and other energy dependent equipment's during night time and/or when not in operation for a significant amount of time.

Abbreviations: ESD-Ecologically Sustainable Development, QBL-Quadruple Bottom Line, WSUD-Water Sensitive Urban Design, EIA-Environmental Impact Assessment, DA-Development Approval.

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